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MORPHOMETRY, LENGTH-WEIGHT RELATIONSHIPS AND LENGTH DISTRIBUTIONS OF FIVE POPULATIONS OF THE FRESHWATER BIVALVE *ASPATHARIA SINUATA* (UNIONACEA, MUTELIDAE) IN NIGERIA

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ABSTRACT

This study examines the shell morphometrics, length-weight relationships, and length distributions of some lotic and lentic populations of the mutelid bivalve *Aspatharia sinuata* occurring in Nigeria. The shell dimension ratios suggest that the populations belong to a common specific unit, and the low variabilities (< 10%) in intrapopulation shell dimension ratios indicate the relative stability of shell form at all sizes and in both sexes. The shell dry weight, tissue dry weight, and live weight increased exponentially with increasing shell length, and in the latter the exponents ranged from 2.8691 to 3.5653, thus suggesting a general isometric growth in the populations. The variations observed in the length frequency distributions of the populations were possibly ecologically determined.

Key words: *Aspatharia sinuata*, populations, shell dimension ratios, length-weight relationships, Mutelidae, unionaceans.

INTRODUCTION

The mutelid bivalve *Aspatharia sinuata* (von Martens, 1883) occurs in many lotic and lentic freshwater habitats in Nigeria, and like many of its relatives in other parts of Africa there is a dearth of information on its biology. Reports on African unionaceans have often dwelt on their distribution, taxonomy and anatomy (see Pilsbry & Bequaert, 1927; Bloomer, 1932; Daget, 1962; Pain & Woodward, 1962; Crowley, 1964; Odei, 1974; Lévêque, 1980). In spite of the abundant information on their taxonomy, there still remains some controversy on this aspect of the mutelids and the related unionids because of the superfluous reliance on shell morphology in describing new taxonomic forms (Kat, 1983a, b).

Although some workers (e.g. Pilsbry & Bequaert, 1927; Pain & Woodward, 1962; Crowley, 1964) recognize mutelids to exhibit frequent variations in shell form, this assertion has seldom been confirmed statistically. According to Lévêque (1980), statistical analyses are indispensable for any meaningful taxonomic work on African unionaceans. The only known biometric information on mutelids is that provided by Crowley et al. (1973) on *Aspatharia complanata* occurring in Bornu State, Nigeria. Morphometry has been studied in a few members of the Unionacea either for establishing the existence of different species complexes or sexual dimorphism (e.g. Tudorancea, 1972; Badino, 1982; Dudgeon & Morton, 1983).

This work aims to determine the characteristic shell dimension ratios of *A. sinuata* by investigating some fluviatile and lacustrine populations in Nigeria. It also examines the length-weight relationships and the length distributions of these populations.

METHODS

The collection sites of *Aspatharia sinuata* in Nigeria lie between latitudes 7°30′ and 8°15′ N, and longitudes 4°30′ and 10°00′ E. Clams were collected from three water bodies in Kwara State, namely Asa Reservoir at Ilorin (the state capital), Oyun Reservoir at Offa, a town about 67 km south-east of Ilorin, and River Oyun downstream the latter lake at the University of Ilorin Main Campus. Samples

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were also taken from Odo-Otin River at Okuku in the north of Oyo State and approximately 20 km south of Offa, and Agbuur River (a tributary of River Benue) at Uga-Mbagwa in Benue State.

The animals were handpicked, and loose littoral substrates were scooped with a sieve (35 meshes/cm^2) in search of spat.

Three shell dimensions (length, height and width) were measured to the nearest 0.01 cm for the determination of their ratios. Length (L) is the longest antero-posterior shell distance; height (H) is the dorso-ventral distance from the umbo to the ventral shell margin perpendicular to the shell length; and width (T) refers to the greatest transverse distance perpendicular to the length and height.

The whole wet weight (live weight), shell dry weight and tissue dry weight of animals whose shell dimensions had been recorded were also determined to the nearest 0.01 g. The soft parts were removed after weighing the live animals; tissues and their corresponding shells were oven-dried at 60°C for 48 hours before weighing. The relationships between shell length and the three weight parameters were ascertained using the linear regression analysis following the logarithmic transformations of weights and lengths.

RESULTS

Figure 1 shows the mean ratios (percent) of height to length (H/L) and width to length (T/L) in the *Aspatharia sinuata* populations. The means of H/L (%, ± standard deviation) were 48.23 ± 3.39, 46.90 ± 1.48, 46.48 ± 1.45, 45.66 ± 1.82, and 44.36 ± 1.87% in Oyun Reservoir, Agbuur River, Odo-Otin River, Oyun River and Asa Reservoir, respectively. The corresponding mean values of T/L were 32.97 ± 2.55, 28.42 ± 1.59, 30.39 ± 1.73, 28.87 ± 2.25, and 27.00 ± 2.14%.

The above presentation follows that suggested by Hubbs & Perlmutter (1943) for investigating racial differences in species populations. The means of the ratios in males and females did not differ appreciably from that computed for all individuals in each population, thus suggesting the existence of similar shell proportions and the absence of sexual dimorphism with regard to shell shape. The coefficient of variability (CV) of H/L(%) ranged from 3.11 in Odo-Otin River to 7.04% in Oyun Reservoir, and for T/L(%) from 5.59 in Agbuur River to 8.93% in Asa Reservoir. Hence, there was a generally low variability (< 10%) in shell dimension ratios within the populations (cf. Tudorancea, 1972).

The relationships between shell length and the three weight parameters (Figure 2 a – c) are described by the hyperbolic equation, $Y = aX^b$, where Y is the weight in grams, X is shell length in centimeters, and *a* and *b* are constants (Table 1). The values of the exponent (*b*) in the length-live weight relationships indicate that the clams were heaviest for length in Agbuur River, while Odo-Otin River recorded the least weights. However, the dry tissue weight increased faster in Oyun Reservoir and was slowest in River Oyun. For shell dry weight, the rate of increase was highest in River Oyun and lowest in Odo-Otin River. It is also observed that in all populations shell weight increased faster than tissue weight.

Figure 3 illustrates the length frequency distributions of the bivalve populations at 0.5 cm class intervals. The Agbuur River samples showed two modes (6.5 and 7.5 cm; length range 3.26–8.94 cm), but the remaining groups were characterised by unimodal length distributions. The respective length ranges of clams in Asa Reservoir, Oyun Reservoir, River Oyun and Odo-Otin River were 3.15–10.15, 3.20–11.50, 1.57–7.51 and 4.57–8.33 cm; their corresponding modal lengths were 6.0, 8.5, 5.0 and 6.5 cm. It is evident from the above that spat were scarce in the samples.

Table 2 gives the mean lengths of clams in the five populations. These and the modal lengths show that there was a general tendency for bigger clams to occur in Oyun Reservoir, and River Oyun to support smaller individuals. Except for the latter population, females tended to be bigger than males.

DISCUSSION

A comparison of the mean shell dimension ratios in the five populations of *Aspatharia sinuata* indicates that they have similar shell forms. Also, the limited coefficient of variability (< 10%) in the ratios within the populations predicts the relative stability of shell form at all sizes, and in males and females. These complement the observation that unionids of the same species possess similar relative shell proportions regardless of size, sex or age (Tudorancea, 1972; Golightly & Kosinski, 1981). However, the slight variations occurring in in-

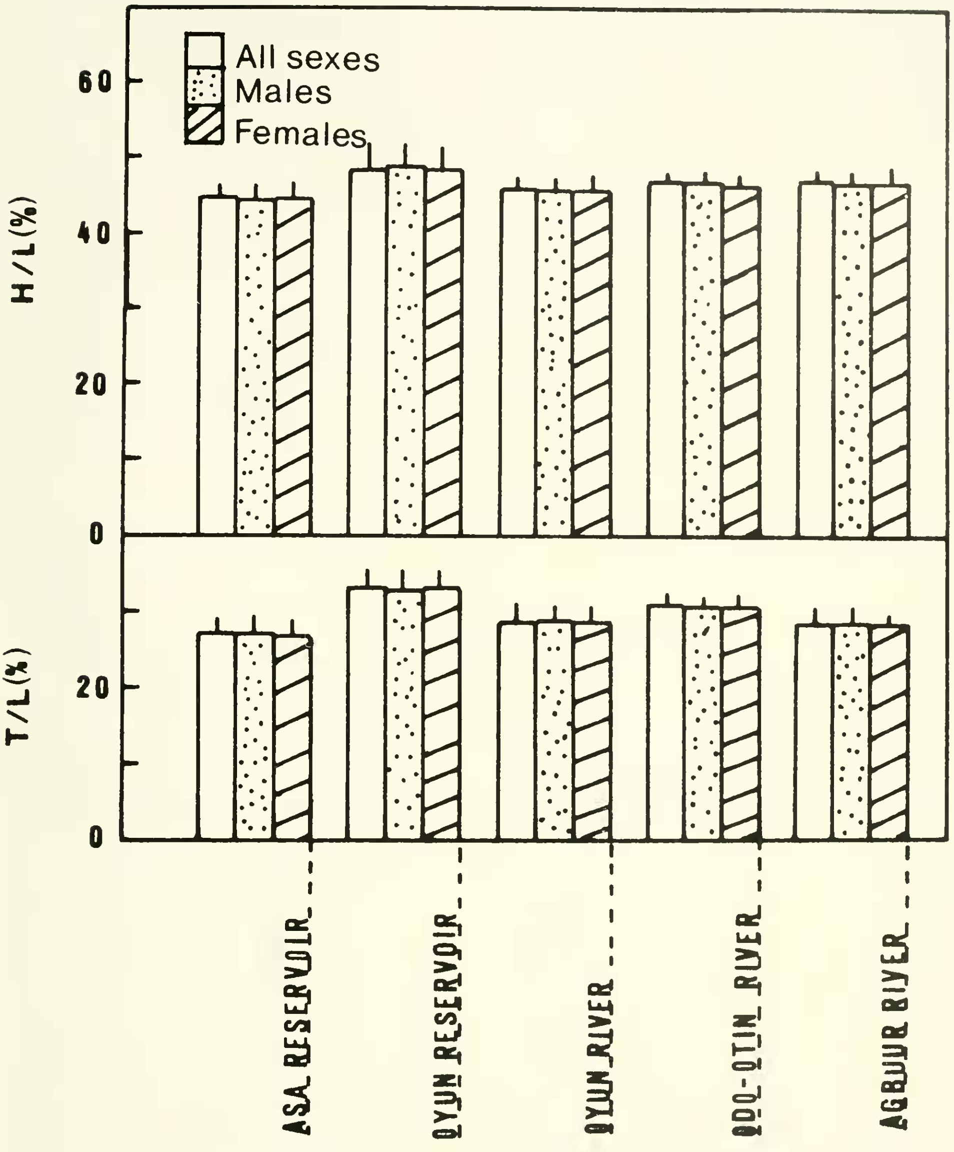

FIG. 1. Shell dimension ratios of five populations of *A. sinuata*. Vertical bars denote standard deviations.

trapopulation shell ratios may be attributed to environmental influences (Pain & Woodward, 1962; Tudorancea, 1972; Chalmer, 1980).

The values of *b* for the shell length-live weight relationships fell within the range 2.5–3.5 found to be typical in most animals (Winberg, 1971). The closeness of these values to 3.0 indicates that the clams portrayed isometric growth which was probably sustained throughout life. The clams also increased shell dry weights more rapidly than tissue dry weights, an observation that is consistent with reports by Cameron et al. (1979), and Golightly & Kosinski (1981) in some unionaceans occurring in southern USA and Canada.

The relatively higher rate of increase in shell dry weight in the River Oyun population is noteworthy. This population recorded the least dry tissue weights for lengths, and their

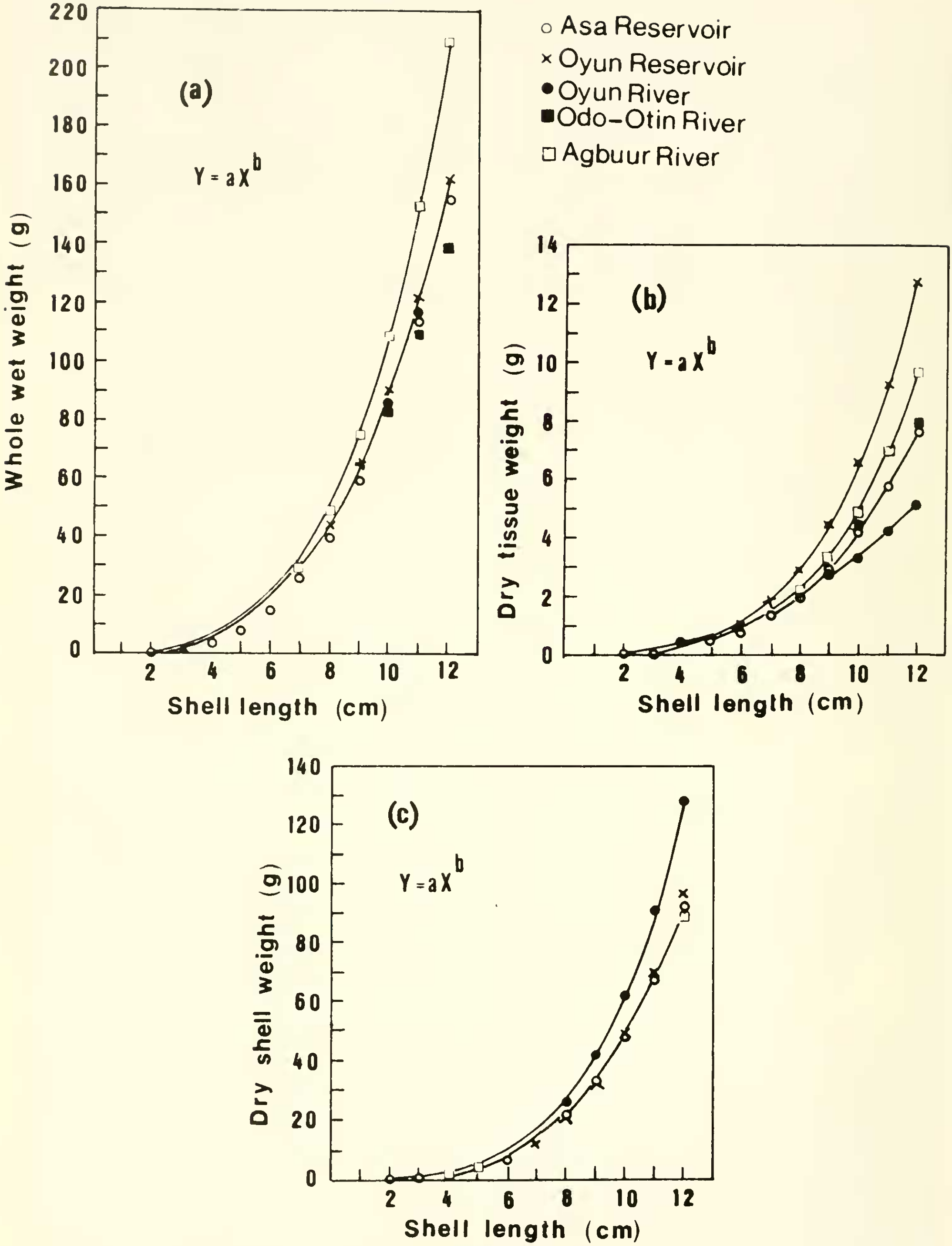

FIG. 2. Relationship between shell length and (a) whole wet weight, (b) dry tissue weight, and (c) dry shell weight in five populations of *A. sinuata*. The curves (fitted by the calculated regressions) are defined by the equation $Y = aX^b$ (see Table 1).

TABLE 1. Relationship of weight parameters to shell length in *A. sinuata* populations. All data fitted to $Y = aX^b$, where Y = weight in grams, X = length in centimeters, *a* = constant and *b* = exponent (sample size ≥ 100; r = correlation coefficient).

Population	Whole wet weight			Dry tissue weight			Dry shell weight		
	a	b ± 1S.E.	r	a	b ± 1S.E.	r	a	b ± 1S.E.	r
Asa Reservoir	0.0350	3.3763 ± 0.1211	0.9744	0.0022	3.2769 ± 0.2082	0.7034	0.0118	3.6077 ± 0.0947	0.9812
Oyun Reservoir	0.0570	3.1990 ± 0.1408	0.9903	0.0015	3.6429 ± 0.1093	0.7983	0.0069	3.8455 ± 0.1159	0.9874
Oyun River	0.0516	3.2187 ± 0.0429	0.9712	0.0174	2.2866 ± 0.4112	0.8627	0.0065	3.9806 ± 0.3033	0.9835
Odo-Otin River	0.1119	2.8691 ± 0.2741	0.9971	0.0029	3.1821 ± 0.3903	0.7864	0.0233	3.3168 ± 0.1633	0.9949
Agbuur River*	0.0298	3.5653 ± 0.0441	0.9948	0.0012	3.6156 ± 0.2163	0.8469	0.0110	3.6329 ± 0.1479	0.9966

*N = 92

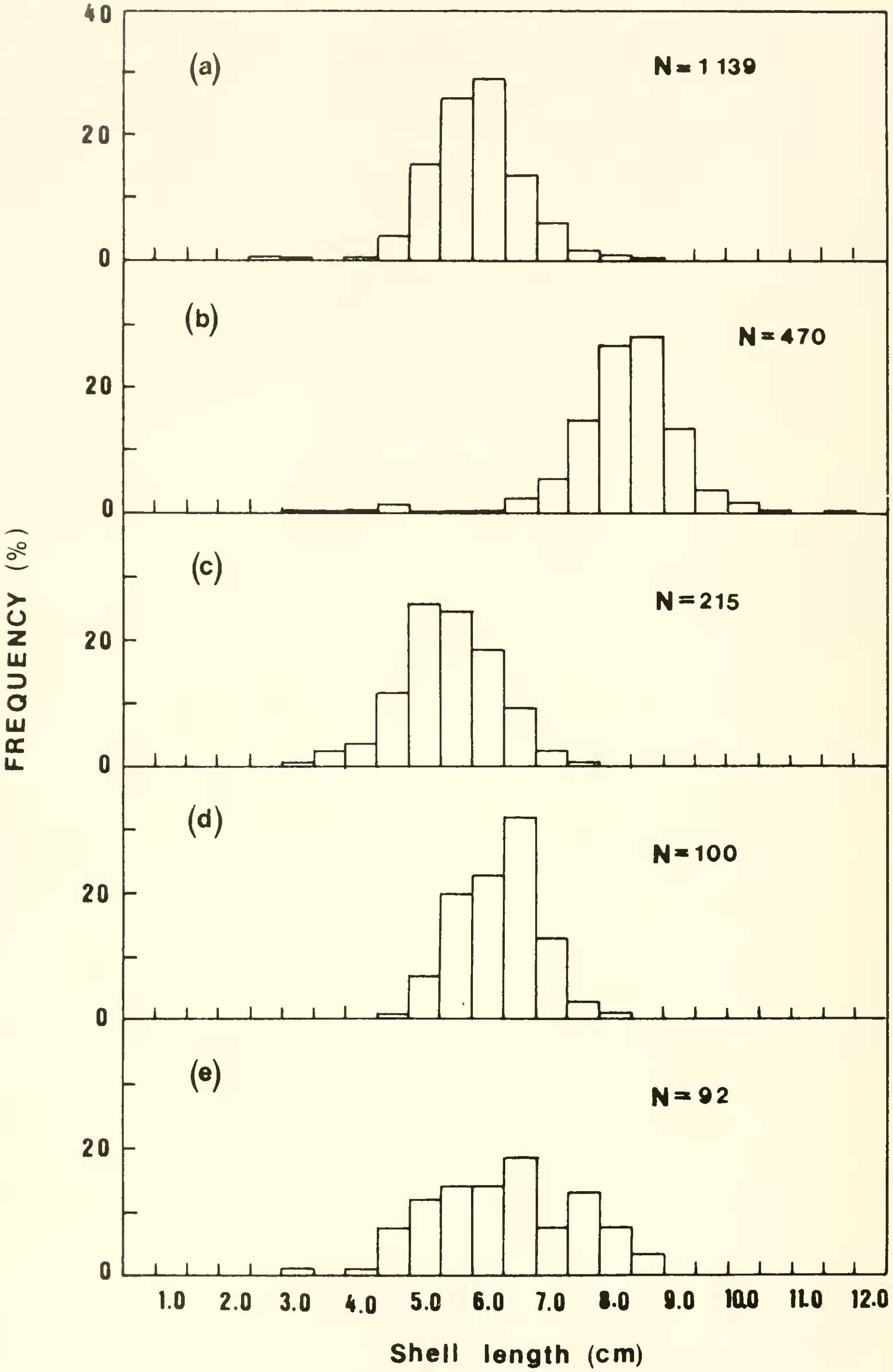

FIG. 3. Length-frequency distribution of *A. sinuata* in (a) Asa Reservoir, (b) Oyun Reservoir, (c) Oyun River, (d) Odo-Otin River, and (e) Agbuur River.

TABLE 2. Mean shell length in *A. sinuata* populations.

Population	Mean length (cm) ± S.D. All specimens	Males	Females
Asa Reservoir	5.80 ± 1.09 (1139)	5.77 ± 0.70 (472)	6.02 ± 0.81 (568)
Oyun Reservoir	8.12 ± 0.97 (470)	8.05 ± 0.78 (242)	8.22 ± 0.97 (188)
Oyun River	5.36 ± 0.46 (215)	5.46 ± 0.69 (112)	5.26 ± 0.83 (103)
Odo-Otin River	6.17 ± 0.66 (100)	6.12 ± 0.64 (52)	6.23 ± 0.66 (48)
Agbuur River	6.24 ± 1.16 (92)	6.15 ± 1.31 (41)	6.31 ± 1.04 (51)

'Number of clams in parentheses.

heavier shells might therefore be a compensation for their lesser tissue dry weights. Thicker and heavier shells would doubtless aid the bivalves to stabilize and maintain their positions under harsh fluviatile conditions. Perhaps much energy was diverted into shell growth than tissue growth.

The variations in the size distributions of the population were probably due to environmental influences resulting in different growth rates (Blay, unpubl. data).

The general scarcity of spat in the *A. sinuata* populations is similar to the observation in *Aspatharia complanata* (Crowley et al., 1973). Nonetheless, this is reported to be a common feature in unionaceans (see Isely, 1911; Crowley, 1957; Negus, 1966; Fisher & Tevesz, 1976). The discovery of spat measuring 0.50–1.29 cm shell length in a sandy bed of a dry season pool in the Oyun River basin was therefore unique. The smaller size of the pool may have contributed to their ready availability. Because the larvae of unionaceans parasitize fish (Arey, 1921; Fryer, 1961, 1970; Trdan, 1981; Kat, 1984), it might be a lot easier for *A. sinuata* larvae to encounter their fish hosts more readily in smaller pools than they would in larger habitats.

It is apparent from this account that while the proportions of shell dimensions tended to be stable in the *A. sinuata* populations, some differences occurred in the length-weight relationships, and size distributions. The relative stability in the shell dimension ratios suggests that the populations belong to a common specific unit, i.e. *Aspatharia sinuata* (von Martens, 1883) proposed by Pilsbry & Bequaert (1927).

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